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Message:

Examiner Cole:

Thank you for agreeing to accept via facsimile the following document, which was cited in the Form PTO 1449 accompanying the Supplemental Information Disclosure Statement submitted to the Office on Tuesday, September 30, 2003. Please contact me if you have any questions.

Respectfully submitted,

FINNEGAN, HENDERSON, FARABOW,
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By: E. W. Adcock

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants: Akira ISHIBASHI et al.

Serial No.: 09/986,627 Group Art Unit: 1771

Filed: November 9, 2001 Examiner: Elizabeth M. Cole

For: A SLIDER FORMED OF FIBER-REINFORCED THERMOPLASTIC RESIN

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VERIFICATION OF TRANSLATION

Honorable Commissioner of Patents and Trademarks
Washington, D.C. 20231

Sir:

I, Shigeki YOSHIDA residing at 21-5, Higashiomiya 7-chome, Saitama-shi, Saitama-ken, Japan declare:

(1) that I am well acquainted with both the Japanese and English languages;

(2) that I translated Japanese Patent Application, Publication No. 6-313050, from Japanese into English;

(3) that the attached English translation is a true and correct translation of the above-identified Japanese Patent Application Publication to the best of my knowledge and belief; and

(4) that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Dated this 15th day of August, 2003.

Shigeki Yoshida

OFFICIAL Signature by: Shigeki YOSHIDA

Japanese Patent Application, Publication No. 6-313050

Date of Publication: November 8, 1994

Application No. 5-125221

Date of Filing: April 28, 1993

Applicant: AISIN CHEMICAL CO., LTD.

Inventor: SHIROUCHI Masaru

[Title of the Invention] MOLDING MATERIAL

[Abstract]

[Object] An object is to uniformly impregnate and disperse a friction adjusting agent into a thermoplastic resin reinforced with aramid long fibers.

[Constitution] A molding material is characterized in that split aramid long fibers are impregnated with a thermoplastic resin containing a friction adjusting agent dispersed therein.

[Scope of Claim for Patent]

[Claim 1] A molding material consisting of aramid long fibers, a thermoplastic resin, and a friction adjusting agent, characterized in that said aramid long fibers are split in the state of monofilaments and impregnated with said thermoplastic resin and said friction adjusting agent.

[Detailed Description of the Invention]

[0001]

[Field of Industrial Application] This invention relates to a molding material to be used in the production of a molded article made of resin, particularly a resin molded article for sliding, such as a lever, a roller, and a gear.

[0002]

[Prior Art] The greatest characteristics of a thermoplastic resin

reinforced with aramid long fibers are the well balanced mechanical properties and excellent abrasion resistance. However, since its friction coefficient is high in comparison with that of the other reinforcing material such as a carbon fiber, it is not suitable for the parts which require a low friction coefficient. In general, as a method for lowering the friction coefficient of a resin, a method of adding a powder of a fluorocarbon resin therein is well known. Also in the case of a thermoplastic resin reinforced with aramid long fibers, the addition of a fluorocarbon resin is effective in lowering its friction coefficient. As a method of addition of a fluorocarbon resin (powder), a method of severally manufacturing thermoplastic pellets reinforced with aramid long fibers and fluorocarbon resin (powder)-containing pellets using a base resin of the same kind and carrying out the dry blend of both pellets before injection molding is most simple and widely used. In this case, however, mutual dispersibility of the fluorocarbon resin and the aramid long fibers is poor, which will give the causees of scattering in both the mechanical properties and the friction coefficient. Particularly, since the aramid fibers are long fibers, the dispersibility of aramid fibers is poor in comparison with that of short fibers. Further, they require such molding conditions that a back pressure or the like is lowered as much as possible to keep the fiber length. Accordingly, in the existing circumstances, the poor dispersibility is aggravated. As a method for solving such a problem, although an attempt to improve the dispersibility by melting and mixing the aramid long fibers of a roving form, a thermoplastic resin, and a powder of a fluorocarbon resin has been made, there is no great difference in various properties as compared with the former method. In view

of these results, it has been confirmed that the above problem will be due to the fact that in a product reinforced with aramid long fibers the particles of fluorocarbon resin do not enter between the fibers because of their long fiber form in comparison with the usual short fibers.

[0003]

[Problem to be solved by the Invention] Accordingly, an object of the present invention is obtain a molding material of a thermoplastic resin reinforced with aramid long fibers and containing a friction adjusting agent mixed therein, in which the friction adjusting agent is uniformly infiltrated into and dispersed between aramid long fibers.

[0004]

[Means for solving the Problem] To solve the above-mentioned problem, the present inventor has studied various molding machines and manufacturing processes. As a result, the inventor has completed the present invention by splitting aramid long fibers and infiltrating therein a thermoplastic resin containing a friction adjusting agent. Specifically, a molding material of the present invention is directed to a molding material consisting of aramid long fibers, a thermoplastic resin, and a friction adjusting agent, characterized in that the aramid long fibers are split in the state of monofilaments and impregnated with the thermoplastic resin and the friction adjusting agent.

[0005] As for the content of the aramid long fibers in the present invention, it is preferred to be 10-40% by weight. If the content is lower than 10% by weight, its reinforcing effect is small. If it is higher than 40% by weight, improvement in strength cannot be expected and any trouble in a molding process will arise. As

the thermoplastic resin, any thermoplastic resin such as nylon 66, nylon 6, PBT, PPD, POM, PP, PES may be used. As the friction adjusting agent, though a fluorocarbon resin, molybdenum disulfide, graphite, etc. may be used, a fluorocarbon resin is particularly desirable. If its content is lower than 5% by weight, it is difficult to fully decrease the friction coefficient. If its content is higher than 20% by weight, the deterioration of strength becomes large. A preferred range is 5-20% by weight.

[0006]

[Function and Effect of the Invention] In the molding material of the present invention, since the aramid long fibers are forcedly split and the thermoplastic resin which is in the molten state and contains the friction adjusting agent thoroughly dispersed therein is introduced and infiltrated therein, the aramid long fibers are present in the state of monofilaments and the thermoplastic resin and the friction adjusting agent exist in the surroundings of the aramid long fibers uniformly. Accordingly, by using this molding material, it is possible to provide an excellent resin product exhibiting small scatterings in the friction coefficient and the mechanical properties.

[0007]

[Example] Now, the present invention will be concretely described with reference to an example. A dry blend of a powder of fluorocarbon resin (product of Mitsui-Du Pont Fluorochemical: Teflon MP 1300) and pellets of nylon 66 (Du Pont Zytel 103HSL) is molten and kneaded with a twin-screw extruder (product of Ikegai Tekko) and continuously supplied to a cross delivery die having the following function. In this cross delivery die, the aramid fibers (Du Pont Kevlar 49) are forcedly split and the molten resin

containing the fluorocarbon resin powder uniformly dispersed therein is infiltrated into the aramid fibers between every monofilaments thereof. By a protrusion method, strands were drawn from the cross delivery die and cut by a cutter to prepare pellets. These pellets consisted of 20 wt% of aramid long fibers, 10 wt% of the fluorocarbon resin, and 70 wt% of nylon 66. It has been confirmed by a photomicrograph of a pellet cross section that the particles of the fluorocarbon resin have entered between the monofilaments of aramid long fibers. By controlling the back pressure on screw so as to be kept in a low level, test pieces for measuring various properties were molded. The measurement results are shown together with those of the comparative examples.

[0008]

[Comparative Example 1] The pellets were prepared in the same way and with the same formulation as in Example except the use of a cross delivery die which does not have the structure capable of forcedly splitting the aramid long fibers. It has been confirmed in the same way as above that the particles of fluorocarbon resin have not entered between the monofilaments of aramid long fibers. The test pieces were molded on the same conditions as in Example, and their properties were measured.

[0009]

[Comparative Example 2] After nylon 66 containing 40 wt% of aramid long fibers and prepared in the same way as in Example and nylon 66 containing 20 wt% of fluorocarbon resin and prepared by a usual melt extrusion were dry-blended in the proportion of 1:1, the test pieces were molded therefrom on the same conditions as above and their properties were measured. The above-mentioned results are shown in Table 1.

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[0010]

[Table 1]

Properties	Measuring method		Example	Comp. Example 1	Comp. Example 2	Reference Example (20 wt% of Kevlar only)
Tensile strength (kg/cm^2)	ASTM D638 (n=10)	$\bar{x}$	1121	1100	1100	1192
		σ	23	60	45	24
Flexural strength (kg/cm^2)	ASTM D790 (n=10)	$\bar{x}$	1493	1460	1450	1583
		σ	19	31	30	17
Modulus in flexure (kg/mm^2)	ASTM D790 (n=10)	$\bar{x}$	469	460	465	489
		σ	16	31	25	17
Iz impact strength (with notch, kg.cm/cm)	ASTM D256 (n=10)	$\bar{x}$	9.51	8.92	9.03	9.12
		σ	0.51	0.65	0.76	0.75
Heat distortion temperature ($186kg/cm^2$, °C)	ASTM D648 (n=3)	$\bar{x}$	248	245	246	251
		R	4	7	6	4
Friction coefficient (10kgx50cm/sec.)	JISK-7218A (continued for 72 Hr)	Max	0.30	0.43	0.41	0.80
		Min	0.14	0.24	0.24	0.68
Friction coefficient (50kgx10cm/sec.)	JISK-7218A (continued for 72 Hr)	Max	0.29	0.43	0.41	0.74
		Min	0.13	0.20	0.21	0.65

[0011] As being clear from the results shown in Table 1, the example exhibited high levels of the mechanical properties and the small scatterings thereof. Further, it exhibited a low level of friction coefficient aimed at and good properties of a small scattering thereof.